

**METHOD FOR CONTROLLING THE TARGET BIT ERROR RATE OF
EACH PACKET IN WIRED AND WIRELESS VIDEO COMMUNICATION
SYSTEMS**

5

BACKGROUND OF THE INVENTION

Field of the Invention

10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345
350
355
360
365
370
375
380
385
390
395
400
405
410
415
420
425
430
435
440
445
450
455
460
465
470
475
480
485
490
495
500
505
510
515
520
525
530
535
540
545
550
555
560
565
570
575
580
585
590
595
600
605
610
615
620
625
630
635
640
645
650
655
660
665
670
675
680
685
690
695
700
705
710
715
720
725
730
735
740
745
750
755
760
765
770
775
780
785
790
795
800
805
810
815
820
825
830
835
840
845
850
855
860
865
870
875
880
885
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
965
970
975
980
985
990
995

The present invention relates to the wired and wireless video communication systems, and a method for controlling the target bit error rate of each packet in wired and wireless video communication systems which support efficiently a video service by controlling the target BER differently in each packet unit. Also, the present invention relates to a video transmission method in wired and wireless video communication systems, which adopts the said method for controlling the target BER.

20 Voice and data services have been mainly served in communication service systems until present, but it is getting certain that video service will be a very important communication service system in the coming wired and wireless video communication systems like
25 IMT-2000, etc.

Description of the Related Art

Most video coder such as MPEG, H.261, H.263
5 compress the video data using techniques such as
discrete cosine transform(DCT), motion
compensation(MC), variable length coding(VLC). Wherein,
the representative example of the VLC is the Huffman
code that allocates small number of bits to the often-
10 occurring pattern in rate, and allocates many number
of bits to the less-often-occurring pattern in rate,
then reduce the total number of bits. However,
resistance against the error becomes lower in case of
compressing video data too much. In other words, if
15 error occurs in a certain part of a video, a video
decoder can't get the sync of the variable length code,
and until the sync is acquired, the video data is got
damaged. Additionally, the video distortion within a
frame occurred by a channel error resulted is
20 propagated into the further frames because the motion
compensation is performed. Wherein, the distortion is
defined as the mean square error(MSE) of difference
between the originally inputted video into encoder and
actually reconstructed in the decoder.

25 To get over the distortion in the video data due

to the said channel error, many error concealment methods are suggested. The error concealment method reconstructs the damaged video area part using the receiving video information only. If this said method is used, although the original video can't be reconstructed perfectly, there is an advantage that can reconstruct the video distortion, which is occurred by the uncorrectable error with channel coding, in real time without increasing of transmission rate.

The error concealment method can be roughly grouped in two parts, a temporal concealment method and a spatial concealment one. In the spatial method, the video is reconstructed using a method like interpolation by using the surrounding video information. With using this method, there is an advantage that it is possible to reconstruct clean outlines of objects. However, there is a disadvantage that because it needs lots of calculating to embody, the complication of hardware is getting increased, and if the surrounding video information is damaged, a capability goes down a lot.

However, in the temporal concealment method, the damaged video area due to using motion vector is replaced with the motion compensated former frame area.

This method has an advantage that if there is no big motion change in the video, or if it is not a case which the video is composed too complicatedly, it shows a good capability. Also, it can be embodied comparative simply. The motion vector can be transmitted separately through a channel having comparatively low error occurring rate. In case not using the said channel, the motion vector of the damaged area can be assumed from the motion vector of the area without errors around the damaged video area. When all of the methods are impossible, zero vector can be used as a motion vector.

When encoded video data passes through the wired and wireless channels and is transmitted, a forward error correction(FEC) method is used in the actual communication system. The FEC method adds particular information on the transmission data and then corrects the errors by using the mentioned information at a receiving end when errors occur. In the conventional video communication systems, the same target of BER is given for all the packets of same kind of services such as telephone, conference through video communication network, and synchronized video service, etc. To satisfy this target of BER, in the conventional method, if other conditions are the same

such as channel environment, etc., the FEC method is performed by using the same parameter of the FEC.

In other words, the convolution coding and the turbo coding use the same code rate and the constraint length, and the BCH code and the lead Solomon code add the same amount of channel coding bit for each packet. After all, when the channel error rate passes through a constant channel, the BERs in the each packet become the same as all the video packets of the same kinds of services.

On the other hand, it is getting certain that for the 3rd generation mobile radio communication systems, the code division multiple access(CDMA) technique will be used. In the CDMA method, user's own code is allocated respectively to communicate. Many users use the same frequency band at the same time. So, the capacity of CDMA system is limited by the entire transmitted power which is received at or transmitted from the base center. Therefore, controlling the transmitted power in the CDMA system is very important and the lots of studies for it have been done. For example, in case of sending the data to the AWGN channel by using BPSK modulation, BER is given as below equation.

[Equation 1]

$$P_b \approx Q(\sqrt{\gamma}) = Q\left(\sqrt{\frac{W \cdot h(t) \cdot P(t)}{R(t) \cdot I(t)}}\right)$$

On the condition that $Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^\infty \exp(-y^2/2) dy$ and γ is energy per bit to interference plus noise density ratio (EINR), W is bandwidth of a channel, $h(t)$ is path loss, $P(t)$ is transmitted power of transmission, $I(t)$ is interference transmitted power plus background noise transmitted power, and $R(t)$ is data rate. It is possible that $h(t)$ is changed due to moving of a mobile terminal, and $R(t)$ or $I(t)$ is changed due to changing of transmission rate in actual system. However, in the CDMA systems, power control is performed so that the BER of the received data is fixed by adjusting $P(t)$. As shown at the equation 1, γ and P_b is not the function for time(t).

When the video information is sent in the conventional CDMA systems, if the services are the same kind of services such as video communication network telephone and conference, and synchronized video services, target BER of all the packets in the video sequence is chosen as the same value. To satisfy the mentioned target BER, power control is applied. So, with the same channel condition, the BER in the each

packet becomes the same as all the video packet of the same kind of services.

As mentioned above, only with the same kind of services, the conventional system controls the target BER for all the packets in the video sequence and controlling transmitted power to maintain this target and performs the FEC to keep the value. But when the video data is transmitted to a channel on which noise exists, controlling the same target BER for all the video packets is not efficient due to the reason as follow. In case of that the packet is damaged during the video information is transmitted split in packet unit, the influence on the image quality is different depending on the characteristic of the video data which is stored in each packet. For example, even though a packet is damaged by channel error, if the packet includes the video information, which can be error concealed well at the decoder, the packet hardly influences on the image quality. On the contrary, if the packet, which includes the video information, which can not be error concealed well at the decoder, is damaged, a big distortion occurs on the video decoder and thus, this packet is more important compared to other packets. So, it is not efficient that controlling the same target BER for all the

packets which support same kinds of services and keep that.

Also, in the conventional system, the target BER of each packet is controlled without concerning the number of the wireless channel through which the video packet passes. In other words, during communication, the packet passes through the wireless channel twice between two wireless ends, once between wireless end and wired end, and none between the wired ends. And in the conventional system, the same target BER is controlled without classifying the mentioned differences. But this method may provide too large target BER between two ends for a packet which passes many times through the wireless channel. And it may provide too small target BER between two ends for a packet which rarely passes or not through the wireless channel. Therefore, it is not desirable that controlling the same target BER in each channel without concerning the numbers of wireless channels which the video packet passes through.

SUMMARY OF THE INVENTION

The present inventions is contrived to solve the problem in the conventional system. The object of the

present invention is to provide the method for
controlling the target bit error rate of each packet
in wired and wireless video communication systems,
which increases the battery duration time with similar
5 image quality without concerning the number of the
wireless channels after controlling the target BER in
the wired and wireless channels gradually depending on
the number of wireless channels which each packets
passes through, or depending on the importance of the
10 information stored in the each packet.

BRIEF DESCRIPTION OF THE DRAWING

FIG 1 is a flow-chart which shows a method for
15 controlling the target bit error rate of each packet
in wired and wireless video communication systems in
accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS.

20 To achieve above mentioned object, the method for
controlling the target BER of each packet in wired and
wireless video communication systems is characterized
by controlling the above mentioned the target BER
25 depending on the importance in the sense of the entire

decoded image quality of the said video packet.

And the importance of the video packet is determined by at least one or more of the followings. One is the estimated distortion value which is
5 occurred in spite of performing the error concealment for occurred error during transmission of the said video packet. And the other is the number of the wireless channel which the said video packet passes through.

10 Also, if the said estimated value of distortion is high, the video packet is determined as more importance, so thus the target for the BER is controlled small. Also, if the estimated value of distortion is low, the video packet is determined as
15 less importance, so thus the target for the BER is controlled large.

Also, the BER of the video packet which passes through the wireless channel is controlled lower than the one which doesn't pass through the wireless
20 channel. And, the BER of the video packet which more often passes through the wireless channel is controlled lower than the one which more less passes through the wireless channel.

Also, in accordance with the present invention, a
25 transmission method of coded video data from

communication systems to the receiving end has the following steps. At the 1st step, the said video data is divided into packet unit, and at the 2nd step, the target BER is controlled for the each said divided packet controls depending on the importance of the corresponding video packet for the entire decoded image quality. And at the 3rd step, the said video packet is managed to satisfy the target BER and is transmitted.

The importance of the video packet at the said 2nd step is determined by the estimated distortion value which is occurred in spite of performing the error concealment for the occurred error during transmission of the said video packet, or the number of the wireless channels which the said video packet passes through.

At the said 3rd step, to satisfy the target BER of the said video packet, the FEC method or transmitted power controlling method on the wireless channel area is used.

At the said 3rd step, if the target BER is small due to the high importance of the said video packet, the code rate of convolution coding and turbo coding becomes higher, or the constraint length becomes longer, and the more channel coding bit of Reed-

Solomon code or BCH code is added.

Also, at the said 3rd step, if the importance of the said video packet is high, more transmitted power is allocated. Contrarily, if the importance of the said video packet is low, less transmitted power is allocated.

The target BER of each video packet such as mentioned above is stored in a header or a tailer of the former packet with video information of the said video packet and is transmitted to the receiving part.

Also, a recording medium which can be read by a computer on which the program is recorded for performing the video transmission method which includes above mentioned 3 steps.

Hereinafter, referring to appended drawings, 'the method for controlling the target BER of each packet in wired and wireless video communication systems and video transmission method' according to an embodiment of the present invention are described in detail as follow.

FIG. 1 is the operation flow chart for the method for controlling of the target BER in the wired and wireless video communication systems according to an embodiment of the present invention.

Referring to FIG. 1, the coded video data(11)

from video encoder is divided into packet unit(12).
The importance of this divided video packet(13) is
determined before transmission through the channel. In
the aspect of determining the importance of each
5 packet, the present invention suggests the estimated
distortion value(14) and the number of the wireless
channels(15) which the said video packet passes
through.

10 The estimated distortion value is the measure
showing how the distortion is occurred when the
receiving decoder performs the error concealment in
case of error-occurring in a packet during
transmitting. In the present invention, an error
concealment operation is performed in advance before
15 the transmitting encoder transmits the estimated
distortion value into each video packet, and this
estimated distortion value is defined as the measured
distortion value. To measure this distortion value, a
hardware performing the same error concealment
20 function at the transmitting encoder as the function
at the receiving decoder is installed. And also, the
distortion, which is occurred by performing the error
concealment function before each packet is transmitted,
is measured. In case of difference of the error
25 concealment depending on the receiving end type, a

hardware has to be installed at the transmitting encoder, which can perform several error concealment method.

In other words, the transmitting encoder requests the information about error concealment method performed at the receiving decoder at the time of controlling to the very first or controlling an arc.

To measure the estimated distortion value without installing the hardware for the error concealment at the transmitting encoder, during not using the hardware for the error concealment in the transmitting decoder, the estimated distortion value of the packet coded in the transmitting encoder can be measured by using the said hardware in the transmitting decoder. However, this method has a disadvantage that the transmitting encoder can not use the hardware for the error concealment for measuring the estimated distortion value in case that a hardware for the error concealment of the transmitting decoder is used by the transmitting decoder. Also, if the error concealment method of the transmitting decoder is different from the one of the receiving decoder, there is a disadvantage that the estimated distortion value may not be the same as the distortion which actually occurs at the receiving decoder.

Also, as mentioned above, one of the standards for determining the importance of the packet is the number of the wireless channel through which the video packet passes. This number of the video packet's passing through the wireless channel is twice between wireless communication systems. And once between the wireless communication system and the wired communication system. And none between wired communication systems. Also, this number found from the first number of the telephone number which attempts to contact the telephone number of terminal. Generally, the BER of the wired channel is quite lower than the BER in the wireless channel. Therefore, the BER as the aspect of termination to termination can be changed largely depending on the transmission packet's number of the passing through the wireless channel. In the present invention, to gain the decoded image quality as similar as possible at the receiving decoder, if other conditions are the same, the BER of a packet which passes twice through the wireless channel is controlled lower than the BER of a packet which passes once through the wireless channel in the wireless channel. And also, the BER of a packet which passes once through the wireless channel is controlled lower than the BER of a packet which never passes

through the wireless channel in the wired channel.

As like this, the importance of each packet is determined by the 2 kinds of information, which are the estimated distortion value of packet(14), and the number of the wireless channel through which the video packet passes.(15) And this information is inputted as a determining block for the target BER of the packet. In this block, the target BER of each packet is determined(17) with considering the importance of each packet depending on the target BER(16) which varies upon the service.(for example, wireless video communication network telephone and conference, wireless VOD, wireless Web., Etc.)

If the service and the number of the wireless channel through which the video passes are the same, the packet with the high estimated distortion value is considered as more important, and the target BER of the packet is controlled smaller. Likewise, if the other conditions are the same, in the wireless channel, the target BER of a packet which passes twice through the wireless channel is controlled smaller than the one which passes once, and in the wired channel, the target BER of a packet which passes once through the wireless channel is controlled smaller than the one which never passes through the wireless channel area.

Man
06-14-2004
~~through the wireless channel area.~~

In the present invention, the FEC method is basically used to guarantee the determined target BER of each packet in the wired and wireless channels.(18) In other words, the code rate of the convolution coding or the turbo coding becomes higher, or the constraint length becomes longer for the important packet. And if the BCH code or Reed-Solomon code is used, the small target BER is guaranteed adding many channel coding bits on the important packet.

Also, in the CDMA wireless communication systems, open loop or close loop transmitted power controlling can be used to guarantee the target BER in the wireless channel. In other words, if other conditions such as course decrease, transmission rate, and interference are the same, more transmitted power is allocated for the important packet, and thus, the BER of the packet becomes low. And less transmitted power is allocated for the less important packet, and thus the BER of the packet becomes high.

The information about the target BER of each packet is transmitted with video information, and so, it can be informed to a switch or a router for the FEC of the wired channel and can be informed to a base station or a mobile station for the FEC or the

transmitted power controlling of the wireless channel.(19) This information can be transmitted through the dedicated control channel, or transmitted through the header or tailer of a previous transmission packet.

Upon the present invention above described, in the aspect of the entire image quality, the target BER of the important video packet is controlled as small, and the one of less important video packet is controlled large. And thus, the forward error correction and using transmitted power is performed efficiently. Therefore, more user can be admitted in the limited bandwidth, and then, the efficiency of the bandwidth of wired and wireless channels can be heighten, and the battery can be lasted longer because in a wireless CDMA system, each mobile station uses transmitted power efficiently.

In addition, the target BER of the video packet which passes often through the wireless channels is controlled smaller than the target BER which passes rarely or less often through the wireless channel area. So, regardless of the number of the wireless channel through which a corresponding video packet passes, the receiving decoder can obtain the constant decoded image quality.